PART 2: SECTION 4

CHAPTER 3

THE ZERO READER FLIGHT DIRECTOR, TYPE Z.L.2

Introduction

1. The Zero Reader Flight Director is a gyroscopic flight and navigational instrument for use during manual control of an aircraft.

2. This instrument reduces instrument flying fatigue by eliminating the mental process of co-ordinating the information supplied from separate sources and determining from this necessary control movements. It is an independent instrument which can be used as a manual standby for a gyro-pilot or as an efficient means of flying on instruments with a degree of accuracy hitherto difficult to obtain.

3. When this instrument is in use, the artificial horizon, turn and slip indicator, gyro-magnetic compass, altimeter, and I.L.S. meter, are reduced to the status of reference instruments.

Purpose

4. The zero reader flight director, which can be used in all weathers, enables the pilot, by watching *one indicator*, to follow a selected flight path with an accuracy comparable with that of an automatic pilot. Depending on the requirements of the selected flight path, the equipment can be used as a flight instrument, a radio navigational aid, or an approach indicator when making landing approaches using the Instrument Landing System (I.L.S.). It can also help the pilot to follow instructions passed during Ground Controlled Approaches (G.C.A.).

Implementation

5. Except for power settings, the control of an aircraft can be reduced to turning, and climbing or diving. Based on this fundamental concept, the two pointers of the flight director indicator tell the pilot to turn port or starboard and to go up or down to maintain precisely a pre-set flight path.

6. The zero reader flight director extracts the information supplied by its own horizon gyro unit (H.G.U.), the G.4B compass, sensitive altimeter, and the I.L.S. cross-pointer meter, and presents it to the pilot on a simple two-element indicator (Fig. 1) which tells him what he must do to achieve and maintain a selected flight path.

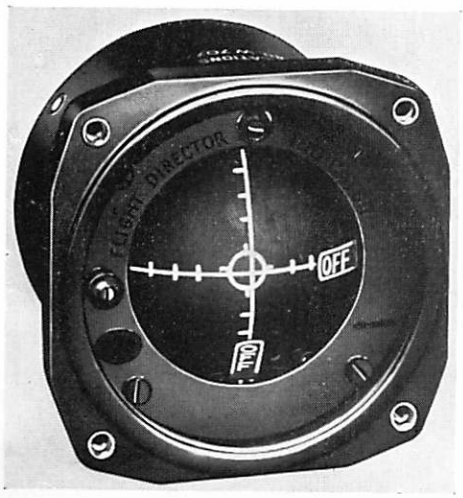


Fig. 1. Zero Reader Indicator.

GENERAL DESCRIPTION

7. As shown in Fig. 2 the equipment consists of the following main units :—

(*a*) Flight computer.
(*b*) Control panel.
(*c*) Indicator.
(*d*) Course selector.
(*e*) Junction box.
(*f*) Horizon gyro unit.

8. The flight computer receives and generates electrical signals which measure the attitude and displacement of the aircraft ; the control panel functions as the central selector of the system ; the indicator instructs the pilot how to move his controls ; the course selector acts as a synchronous repeater from the G.4 compass ; and the junction box interconnects all the units of the system. The H.G.U. is fitted to provide pitch and roll signals for the flight computer

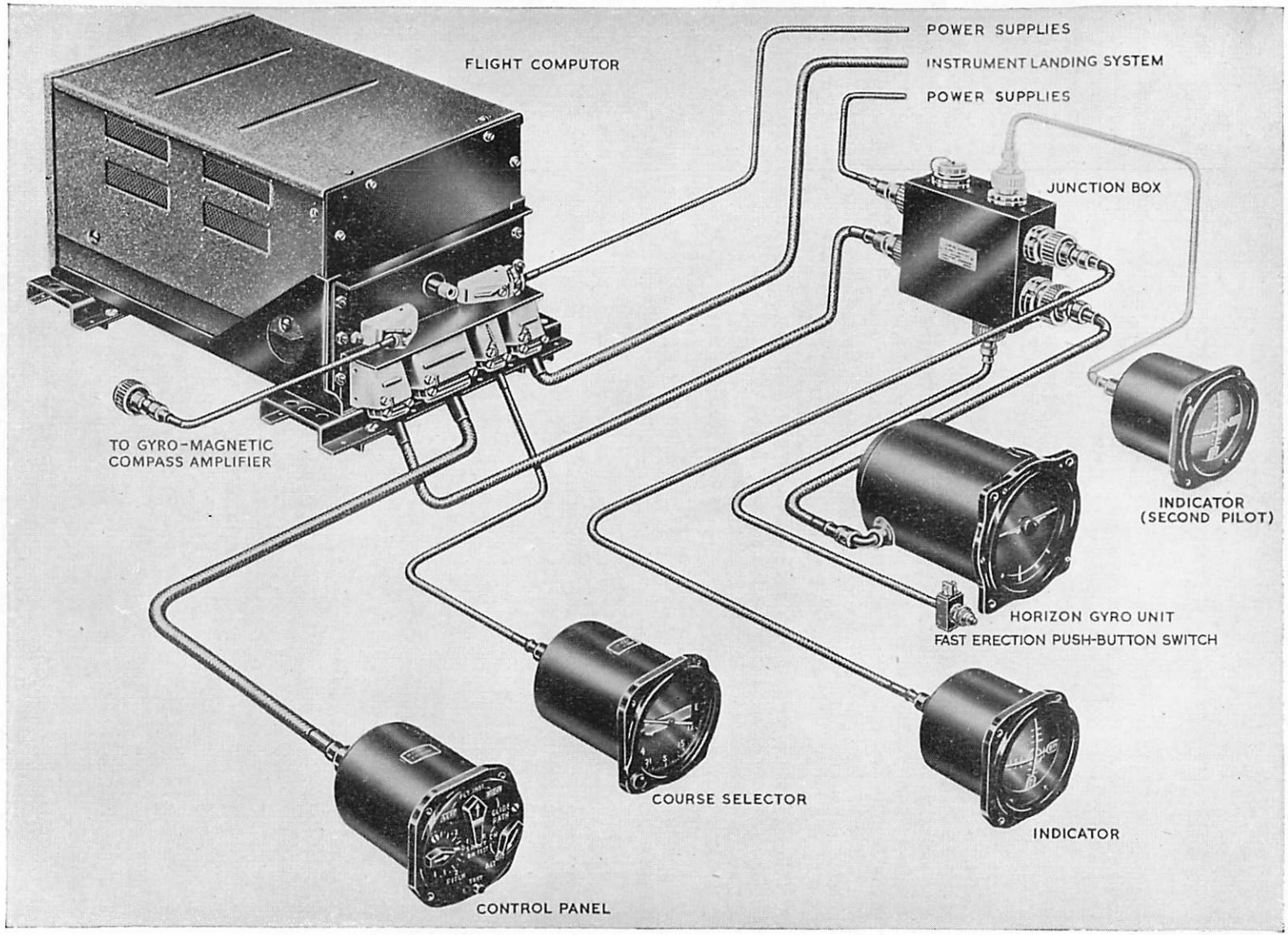


Fig. 2. Zero Reader Flight Director—Equipment Layout.

and may also be used by the pilot as an artificial horizon, in which case it is mounted on the instrument panel. Should it not be required for use as a flight instrument the H.G.U. may be located at some convenient point elsewhere in the aircraft.

Indicator

9. The indicator, which is mounted centrally on the flight instrument panel, is a parallel motion cross-pointer meter. The vertical pointer is actuated by heading, roll, or radio signals, *e.g.* signals from an I.L.S. localizer beam. The horizontal pointer is actuated by pitch, altitude, or I.L.S. glide path signals.

10. The indicator is a demand instrument, *i.e.* it instructs the pilot *what action he must take* to follow a selected path or reach a set-in objective. It is in no sense an indicator of attitude or of directional displacements.

11. The main selector on the control panel is used to select a group of references required when following a set flight path, *e.g.* an I.L.S. approach.

12. Signals are presented at the indicator in such a way that, when the pointers are made to cross at the centre of the zero circle which represents the aircraft, the pre-selected flight path is being flown. If the aircraft departs from the pre-selected flight path the pointers become displaced from the centre zero, and to regain the flight path the centre zero, *i.e.* the aircraft, must in effect be "flown" to, and held on, the intersection of the pointers.

13. No anticipation on the part of the pilot is necessary and all aircraft control movements to centralize the pointers should therefore be made positively.

14. It should be noted that the flight path followed by an aircraft in response to the demands of the flight director indicator may not, at its inception, coincide with any pre-selected heading, localizer range beam, altitude, or glide slope ; but, provided that the pointers of the indicator are maintained at zero, this path will lead to any such objective and will thereafter coincide with it. The reason for this can be best understood by considering the action of the flight computer.

Flight Computer

15. This component of the equipment is essentially an electronic mathematical computer. It receives reference signals from selected attitude and displacement measuring instruments within the aircraft and converts them into D.C. signals which are fed directly to the sensitive mechanism of the indicator.

16. The flight computer uses these references continuously to provide the indicator with correct information which enables the pilot to follow and hold an optimum flight path to the set-in objective.

Data Signals

17. Three basic references are fed continuously and automatically to the indicator via the computer. They are the roll and pitch displacement signals provided by the H.G.U. and the azimuth displacement from the course selector (one pointer of which is a repeater of the G.4 compass heading). It is emphasized that since the zero reader gets heading information from the G.4 compass, the heading indicator of the zero reader cannot be used as an alternative to the G.4 compass if the latter becomes unserviceable.

18. The pitch signals can be modified, by a pitch trim setting knob on the control panel, to provide an angle of climb or descent so that the indicator will show aircraft pitch movement in relation to the desired pitch angle.

DETAILED DESCRIPTION OF THE INDICATOR, CONTROL PANEL, AND COURSE SELECTOR

Indicator

19. Graduated marks are provided on the dial to indicate the magnitude of pointer displacement. "OFF" flags on the dial show themselves if any of the major components fail.

20. An additional indicator may be fitted in the second pilot's position.

21. The indicator face is a section of a sphere in shape, and the cross bars (Fig. 1) are curved to follow its surface and reduce parallax error. A zero is marked at the centre of the face, and the flight path as selected on the control panel and course selector is approached or achieved when the bars intersect at the centre of the zero circle. Graduations on the face represent half, three-quarters, and full scale deflection of the bars.

22. If the flight director is being used with I.L.S. equipment, any failure in the I.L.S. system which causes the I.L.S. meter OFF flags to appear, also causes the OFF flags of the zero reader indicator to show. Pressing the test button on the control panel (Fig. 3) also causes the indicator flags to appear, but they should disappear as soon as the test button is released, indicating that the equipment is functioning.

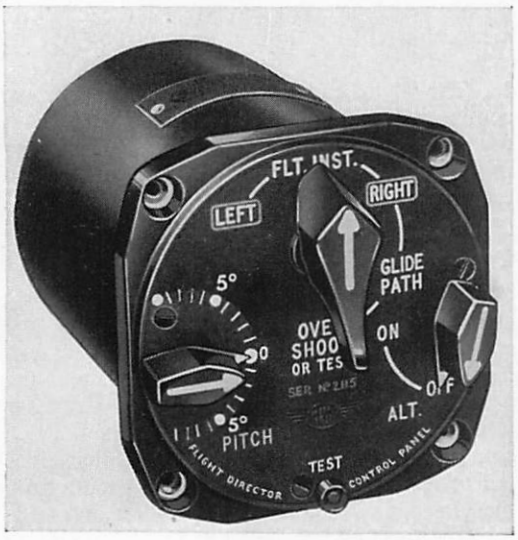


Fig. 3. Zero Reader Control Panel.

Control Panel

23. The control panel (Fig. 3), used in conjunction with the course selector, enables the pilot to select the desired flight path. The panel has four controls which are electrically interlocked. These are : main selector switch, test button, altitude switch, and pitch control.

24. **Main Selector Switch.** This is a rotary switch having five positions ; namely, LEFT, FLT. INST., RIGHT, GLIDE PATH, and OVERSHOOT OR TEST. LEFT and RIGHT are marked in a blue frame and are identified with the blue sector of the I.L.S. localizer beam. This switch is used to select the signals required for a desired flight path, as shown in the following table.

MAIN SELECTOR SWITCH

Stage of Flight	*Position of Main Selector Switch*	*To be Selected Manually*	*Flight Director then Gives this Data*	*Remarks*
Outbound Flight (QDR).	LEFT	Alt. Switch and Pitch Control.	Pitch, Roll, Heading, and I.L.S. Localizer.	Localizer sensed for sector on left.
Cross-Country Flying	FLT. INST. ...	Alt. Switch and Pitch Control.	Pitch, Roll, and Heading.	—
In-bound Flight (QDM).	RIGHT ...	Alt. Switch and Pitch Control.	Pitch, Roll, Heading, and I.L.S. Localizer.	Localizer sensed for blue sector on right. Localizer sensitivity increased.
Final Approach ...	GLIDE PATH	—	Pitch, Roll, Heading, I.L.S. Localizer, Glide Path, "Fly Down" Datum.	Final approach.
Overshooting ...	OVERSHOOT	—	Pitch, Roll, Heading, and "Fly Up" Datum.	TEST button operates in this switch position only.
Testing	OVERSHOOT (TEST).	Pressing TEST button injects fixed "Fly Up" and "Fly Left" signals.	None.	

25. **Test Button.** This is a spring-loaded push-button switch located directly below the main selector switch. It is operative only when the latter is set to OVERSHOOT. When the button is pressed a relay in the flight computer is energized and removes all normal input signals. Instead of the normal input signals a direct current signal is injected. This passes through all stages of the pitch and roll channels and, provided that both channels are functioning satisfactorily, deflects the horizontal and vertical bars of the flight indicator half full scale up and to the left respectively and causes the warning flags to drop into the OFF position. On some installations the deflection may not be half full scale. This accords with the policy of ensuring that the flight director indicator cannot give an indication that would lead to a dangerous change of pitch attitude. On such installations the pitch test signal is reduced and a label marked "$\frac{1}{4}$ UP" is attached to the equipment.

26. **Altitude Switch.** The control knob of this two-position rotary switch is marked "ALT" and enables the altitude control to be engaged when the main switch is in the positions LEFT, FLT. INST., or RIGHT. Electrical interlocks return the spring-loaded altitude switch to OFF whenever the main selector switch is turned to either GLIDE PATH or OVERSHOOT. The altitude switch is held in the ON position by a D.C. clutch. To avoid any damage to the sensitive mechanism it is arranged that, if the aircraft should rise or fall an appreciable distance (the equivalent of 600 feet at sea level) from the engaged altitude, the solenoid will be de-energized and the altitude switch will return to the OFF position. Should it be switched back to the ON position the control will engage at the new height.

27. **Pitch Control.** This control enables the pilot to set-in the desired angle of pitch attitude, *i.e.* to change the normal pitch datum when the fore-and-aft trim of the aircraft is altered by load conditions, variation of airspeed, use of flaps, etc., *i.e.* when a different attitude is required to fly level or to climb or descend. It is operated by movement of a knob which registers the angle against a background scale (Fig. 3). The function of the pitch control is to change the datum of the pitch signal applied to the indicator so that at the required angle of attack the horizontal bar indicates zero. The markings on the pitch scale denote a definite change in the pitch angle, *e.g.* 5° movement of the pitch control causes 5° change in the pitch attitude. Each graduation represents 1°, and the total range covered is $\pm 20°$; but movement of the knob can continue beyond the scale. Electrical interlocks allow this control to be used at switch positions LEFT, FLT. INST., and RIGHT only, and automatically return it to zero if the main selector switch is turned to positions GLIDE PATH or OVERSHOOT. It also returns to zero if the altitude switch position is changed. The pitch control can be reset provided that the main selector switch is not at GLIDE PATH or OVERSHOOT.

Course Selector

28. The course selector (Fig. 4) embodies two pointers—the course (parallel) pointer, and the heading pointer—which register against a compass scale graduated in 2° divisions. The heading pointer repeats the signals of the G.4 compass. The course pointer is geared to the course-setting knob located on the lower left corner of the instrument dial. When a change of course is desired this knob is rotated to move the course pointer to a new setting. A "fly left" or "fly right" signal then appears on the indicator and remains until action is taken to start a turn in the correct sense and re-align the heading and course pointers.

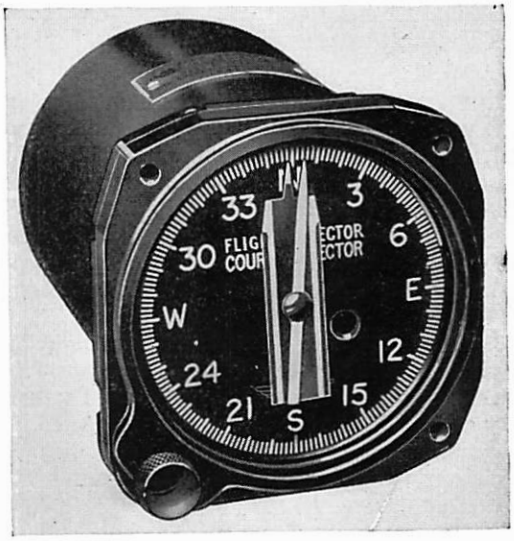


Fig. 4. Zero Reader Course Selector.

PRINCIPLE OF OPERATION

29. The flight computer receives electrical signals (which vary in amplitude and sign) from the H.G.U., the G.4 compass, the internal altitude switch, and the I.L.S. radio receivers. These signals are combined in the flight computer to measure the attitude and displacement of the

aircraft relative to the selected flight path. The indicator is fed with the computed signals and, if the attitude of the aircraft is in error relative to the selected flight path, the indicator bars are displaced from the zero circle. Such bar displacements indicate the direction in which the zero circle, *i.e.* the aircraft, must be manœuvred to regain the required flight path.

30. As corrective action is taken the flight computer receives signals opposing those which caused the displacements. When sufficient control has been applied the signals cancel out and the indicator cross bars return to zero, indicating that the aircraft is approaching the correct attitude.

31. An example of the use of the instrument to maintain an I.L.S. approach flight path is illustrated in Fig. 5 and explained in the following paragraphs. For simplicity the explanation is confined to the azimuth control function. The illustration includes the indications shown by the flight indicator and the other instruments at various stages of the approach to the beam centre. Arbitrary figures representing the magnitude and sign of response signals are given above each instrument, and the beam width has been exaggerated for clarity of illustration.

32. **Stage A.** The aircraft in position A is on the correct heading but is flying a track to the left of the I.L.S. localizer beam. The flight instruments are indicating straight and level flight, and the I.L.S. meter displays a "fly right" signal. At this stage the only signal applied to the vertical bar of the flight indicator is a maximum "fly right" signal from the I.L.S. receiver.

33. **Stage B.** The pilot turns starboard by applying sufficient right bank to zero the "fly right" signal of the flight indicator. The roll signal provided by the H.G.U. cancels the I.L.S. localizer signal and brings the flight director indicator to zero indication. The instruments therefore read :—

(*a*) I.L.S. meter	"Fly right" ...	+5
(*b*) H.G.U.	"Right bank"	−5
(*c*) Course selector ...	"On course"...	0
(*d*) Indicator	"Zero" ...	0

34. **Stage C.** The turn begins, and the aircraft moves towards the centre of the localizer beam. The cancelling signal now has two components, one due to the applied bank and the other to the change of heading, the latter developing in proportion to the difference between the direction of the beam and the heading of the aircraft. Consequently the localizer error signal decreases continuously. Meanwhile the increase in the cancelling signal deflects the vertical bar of the flight indicator to the left, and to keep the bar zeroed the pilot has to reduce the angle of bank. This reduces the rate of turn and the heading signal approaches maximum. The instrument indications are now :—

(*a*) I.L.S. meter	"Fly right" ...	+3
(*b*) H.G.U.	"Level" ...	0
(*c*) Course selector ...	"Heading into beam" ...	−3
(*d*) Indicator	"Zero" ...	0

35. **Stage D.** The aircraft is now in level flight and heading into the beam. The I.L.S. localizer signal decreases rapidly as the aircraft approaches the beam centre, causing the vertical bar to move again to the left. To maintain zero, therefore, left bank must be applied ; and at stage D the aircraft is turning left onto the centre of the beam track. The roll signal now adds to the I.L.S. signal and both are balanced by the heading signal. Instrument indications at stage D are therefore :—

(*a*) I.L.S. meter	"Fly right" ...	+1
(*b*) H.G.U.	"Left bank"...	+1
(*c*) Course selector ...	"Heading into beam" ...	−2
(*d*) Indicator	"Zero"	0

36. **Stage E.** During this final stage of the approach, when the displacement signal is decreasing to zero, the balancing signals must also be reduced at the same rate to keep the bar at zero. Thus by moving the controls appropriately the pilot brings the aircraft into the centre of the beam. At stage E all four indicators are at zero, and the aircraft is heading straight towards the centre line of the runway.

37. Thus keeping the indicator at zero throughout the approach with a diminishing localizer signal has required the application of signal control also in diminishing proportions, its instantaneous value being balanced by the demands of the moment.

38. This explanation deals only with the azimuth function and with the special case of the I.L.S. approach. The same principles apply to pitch control in the vertical plane and to any combination of the two axes.

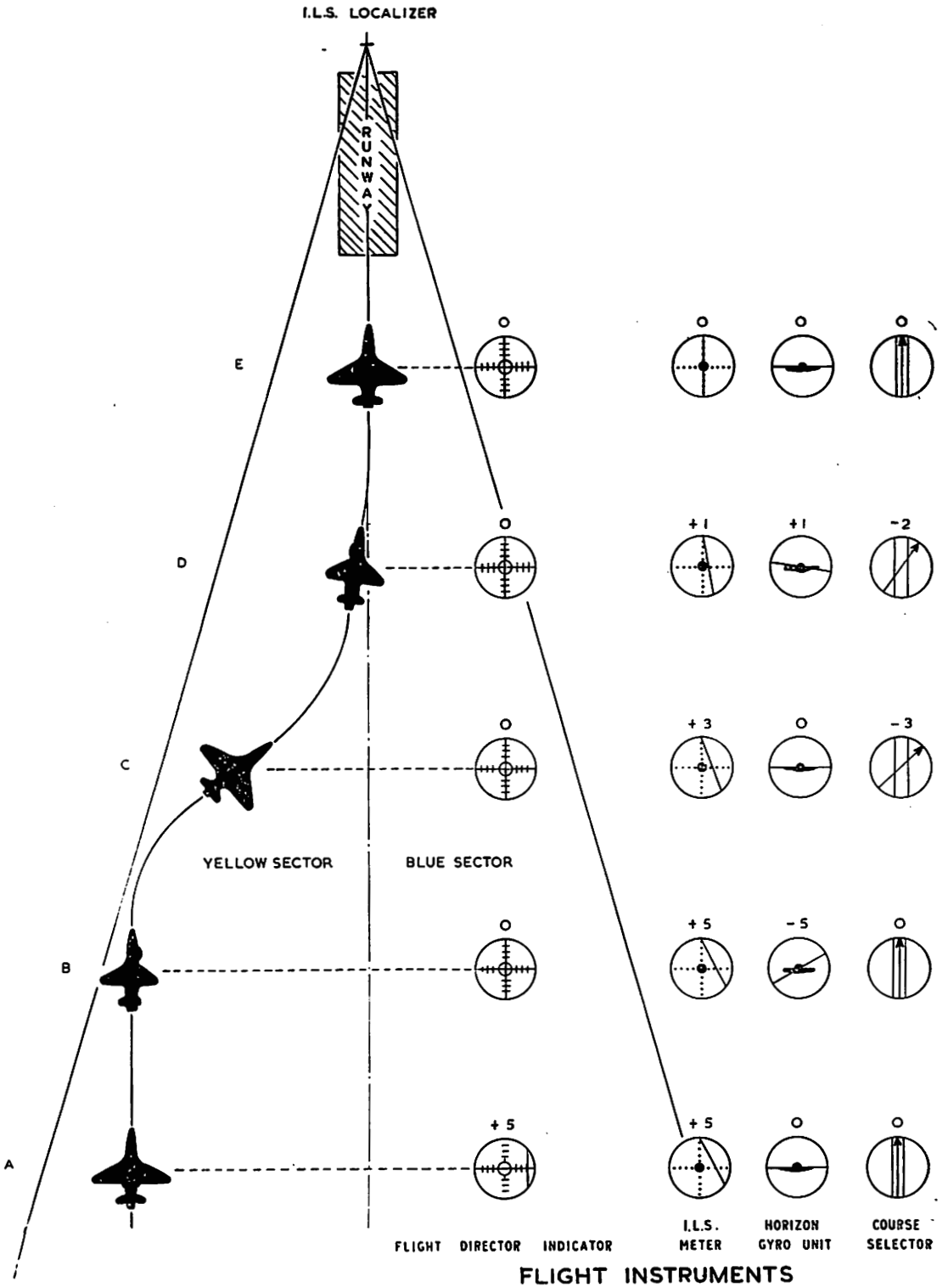


Fig. 5. I.L.S. Approach Using the Zero Reader.

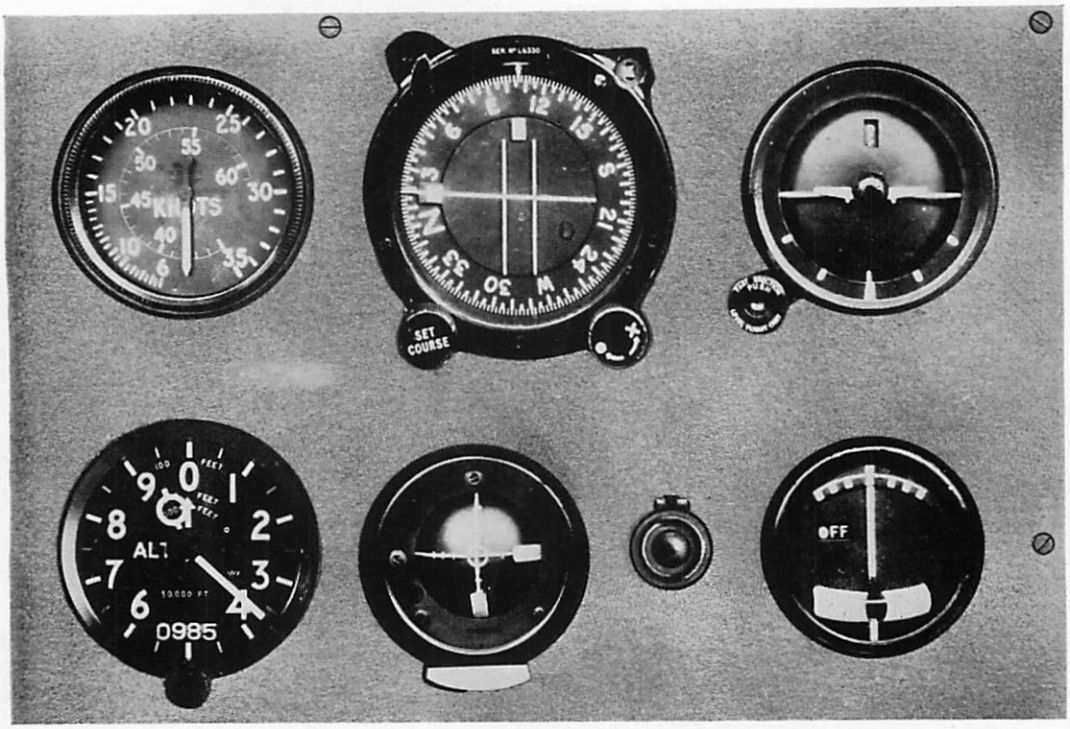


Fig. 6. Flight Instrument Panel, Showing the Zero Reader Indicator.

39. A similar technique is applicable in association with other radio landing aids and in point-to-point navigation.

OPERATION

40. This information is included as a guide to a general understanding of the function of the zero reader flight director, Type Z.L.2, under various conditions. These instructions are not however, mandatory ; and pilots should refer to Pilot's Notes for individual types of aircraft for any special zero reader operating instructions that might be included.

41. The aircraft must always be manœuvred to bring both the indicator cross bars to zero *by flying the circle towards their points of intersection.* The required flight path is being approached or flown when both bars intersect at the centre of the circle. Sensing of the cross bars is shown in Fig. 7.

42. The position of the horizontal bar of the indicator is *not* a true indication of pitch attitude when the altitude switch is turned ON and the main selector switch is at GLIDE PATH or OVERSHOOT, or if the pitch trim setting knob is not at zero.

43. The circuit is so calibrated that it is impossible for the zero reader to demand a dangerous change of attitude. The indications of the instrument are damped to ensure that if the flight indicator is followed the optimum course is taken to the new attitude.

44. The system is not designed to provide indications of roll or pitch attitude, or the extent of heading, localizer, or glide path displacements.

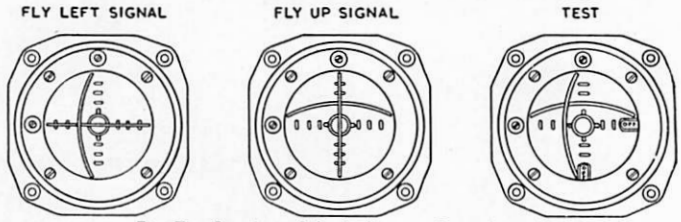


Fig. 7. Sensing of the Indicator Cross Bars.

When confirmatory information is required reference should be made to the basic flight instruments.

45. The altitude switch should always be switched OFF when there is need to hold a specific altitude, or in conditions of severe turbulence.

46. When the zero reader is used during an approach or below 1,500 feet, attitude, course, airspeed, height, and position must be checked in relation to the I.L.S. by frequent reference to the appropriate instruments.

Pre-Flight Checks

47. The pre-flight checks are :—

(*a*) Switch on the power supplies and allow 30 seconds for the valves to warm up. Check that the OFF flags are clear of the indicator face.

(*b*) Set the main selector switch to FLT. INST.

(*c*) Synchronize the G.4 compass with the aircraft heading.

(*d*) Align the heading and course pointers of the course selector and ensure that the H.G.U. bank angle pointer is at zero. Check that the vertical bar of the flight director indicator is exactly in the centre.

(*e*) Turn the course-setting knob clockwise, and check that the indicator vertical bar moves to starboard.

(*f*) Turn the course-setting knob anti-clockwise, and check that the indicator vertical bar moves to port.

(*g*) Ensure that the altitude switch is turned OFF.

(*h*) Turn the pitch control anti-clockwise, and check that the indicator horizontal bar moves up.

(*j*) Turn the pitch control clockwise, and check that the indicator horizontal bar moves down.

(*k*) Switch the I.L.S. equipment ON (if fitted) and allow 30 seconds for the valves to warm up.

(*l*) Turn the main selector switch to RIGHT.

(*m*) Align the heading and course pointers, and check that the indicator vertical bar is deflected in the same direction as the vertical bar of the I.L.S. meter.

(*n*) Turn the main selector switch to OVERSHOOT, and check that the heading and course pointers are approximately aligned.

(*o*) Press the test button, and check that the horizontal and vertical bars of the indicator move up and to the left respectively, and that the OFF flags appear. Deflection of the bars should be half scale, but only quarter scale if a tablet marked "½ UP" is attached to the equipment.

(*p*) Release the test button, and check that the indicator bars return to their original positions and that the OFF flags disappear.

(*q*) Return the main selector switch to FLT. INST., and return the pitch control to zero.

Take-Off and Climb

48. Check that the altitude switch is OFF, main selector switch at FLT. INST., and that the indicator OFF flags have cleared.

49. Adjust the horizontal bar, by means of the pitch control on the zero reader control panel, to give the desired fly-up datum for the initial climb after take-off.

50. With the aircraft lined up ready for take-off, align the heading pointer with the course pointer on the course selector, and check that the heading indicated is the same as the runway bearing. While taking off keep the vertical bar on the indicator at zero, and when airborne maintain both bars on zero.

51. Set the required course on the zero reader course selector, and zero the vertical and horizontal bars of the indicator by flying so that the circle moves towards the point where the bars cross. Turns of more than 165° require intermediate heading selection.

52. Adjust the pitch control, if necessary, so that with the correct climbing power setting the appropriate airspeed is maintained by flying with the horizontal bar at zero.

Cruising

53. Fly level at the required height and turn the altitude switch slowly to ON. Check that the pitch control knob on the zero reader control panel has returned automatically to zero. If, after the altitude switch is engaged, the aircraft maintains a height slightly above or below the selected height, correction may be made by up or down adjustment of the pitch control knob. This correction compensates for attitude variation caused by different load distributions or power setting changes, and should not be made until the aircraft has settled down after levelling off or after any change in power setting.

54. The required course is maintained by setting it on the zero reader course selector and flying with the indicator at zero thereafter.

55. In extreme turbulence the altitude switch should be turned OFF to prevent the changes in altitude giving pitch signals. Moreover, under such flight conditions the aircraft attitude should be held and altitude corrections should be made only if the aircraft height approaches the lower safety limit.

I.L.S. Approach

56. Serviceability of the zero reader equipment should be verified in the air before the start of an I.L.S. approach by turning the main selector switch to OVERSHOOT, aligning the course selector, and pressing the test button. The flight indicator should then read half full scale "fly up" and "fly left" (quarter full scale indication on certain aircraft as already explained). After this test the main selector switch should be turned to FLT. INST., and the altitude switch turned ON if required and OFF when any subsequent descent is made to the local I.L.S. approach height.

57. The appropriate approach height and runway heading should be determined from the Pilot's Handbook (A.P. 3193E) and a descent made to the height specified. On reaching the required height the altitude switch should be turned ON. The pilot should then turn the main selector switch on the control panel to the required position, namely :—

(*a*) LEFT for outbound localizer tracking, or

(*b*) FLT. INST. if not flying on an I.L.S. beam, or

(*c*) RIGHT for localizer interception and inbound localizer tracking.

58. If the approach procedure requires an outbound track along the beam beyond the outer marker and then a procedure turn to fly inbound along the beam, the sequence is as follows.

59. Fly from the homing facility with the main selector switch in the FLT. INST. position (Fig. 8), set the desired course on the course selector, and turn the altitude switch ON when the correct altitude for the initial approach is reached. Upon intercepting the localizer beam turn the main selector switch to LEFT, and set the beam QDR on the zero reader course selector. If the aircraft is then flown so as to keep the indicator bars at zero the aircraft will follow the localizer beam QDR.

60. After flying beyond the outer marker for the stipulated period, turn the main selector switch to FLT. INST., set the initial course for a procedure turn on the zero reader course selector, and make the turn as shown in Fig. 8. Normally, after one minute on this leg there follows a Rate One turn through 180°, then another turn onto the localizer inbound leg when the I.L.S. meter indicates interception of the localizer beam. This turn is achieved by turning the zero reader course selector after one minute in the desired direction through 180° (in two steps) and flying the aircraft according to the demands of the indicator.

61. The new heading should be maintained until the *I.L.S. meter* vertical needle shows a definite departure from full scale deflection. QDM should then be selected on the zero reader course selector, and RIGHT on the main selector switch. Subsequently, if the demands of the indicator are followed, the result will be a smooth inbound entry into the localizer beam.

62. For a straight-in approach from the homing facility, fly with the main selector switch set to FLT. INST. and select a course on the zero reader course selector so as to intercept the I.L.S. localizer beam. This course should be such that the aircraft approaches the beam at an angle of 45° to 60°. On reaching the initial approach height turn the altitude switch ON, and when the vertical needle of the I.L.S. meter shows a definite departure from full scale deflection set the QDM or QDMD (described later) on the zero reader course selector, and RIGHT on the main selector switch. Keeping the indicator at zero will then result in a smooth entry into the localizer beam.

63. **Continuation to the Glide Path Beam.** Fly the aircraft so as to keep the indicator at zero and, when the I.L.S. glide path pointer moves from its maximum "fly up" position to the horizontal position to indicate that the aircraft is in the centre of the glide path beam, turn the main selector switch to GLIDE PATH and continue to fly with zero on the indicator.

64. **Glide Path Descent.** When the main selector switch is turned to GLIDE PATH the altitude switch is turned OFF automatically and the pitch control also returns to zero. The horizontal bar on the indicator may deflect when the main selector switch is turned. The aircraft controls should then be moved to zero both bars on the indicator. The indicator is

calibrated so that the aircraft is flying slightly above the centre of the glide path when the indicator is at zero. The I.L.S. meter therefore registers between half and one dot "fly down" during the glide path approach.

65. After the aircraft has been stabilized on the localizer beam and is laterally level, any angle between the course pointer and the heading pointer on the zero reader course selector represents the drift angle. If a QDMD, *i.e.* a local beam QDM corrected for airfield-level drift, has been passed by the airfield controller and set on the zero reader course selector, any drift angle observed on the approach to the glide path may be ignored since it will progressively decrease and disappear during the final approach as a result of wind gradient effect. If no QDMD has been passed by the airfield controller, however, the drift angle should be noted and the course selector reset to effect half-drift correction. The remaining indicated drift should be ignored thereafter since it will decrease and eventually disappear towards the lower end of the glide path.

66. The accuracy of the approach is monitored by the I.L.S. meter, and this instrument should be consulted frequently.

Ground Controlled Approach

67. Carry out the same airborne serviceability check of the equipment as for an I.L.S. approach. Turn the main selector switch to FLT. INST., set the headings obtained from the ground control on the zero reader course selector, and move the flying controls so as to zero the indicator. On reaching the holding height specified by ground control maintain level flight by turning the altitude switch ON.

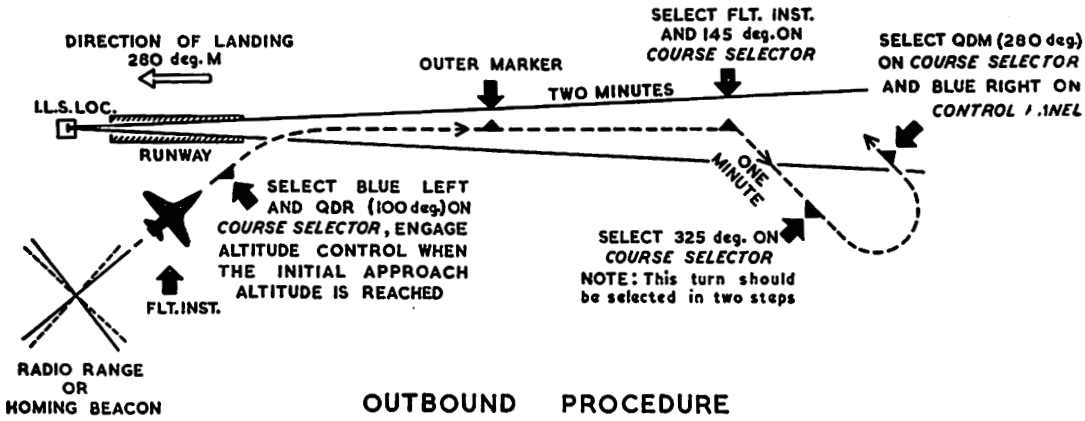
68. When ordered to descend, turn the altitude switch OFF and adjust the pitch control knob and throttle so that the descent complies with the ground control instructions. When approaching under ground control it should be realized that the function of the zero reader flight director is that of a co-ordinating flight instrument.

Overshooting

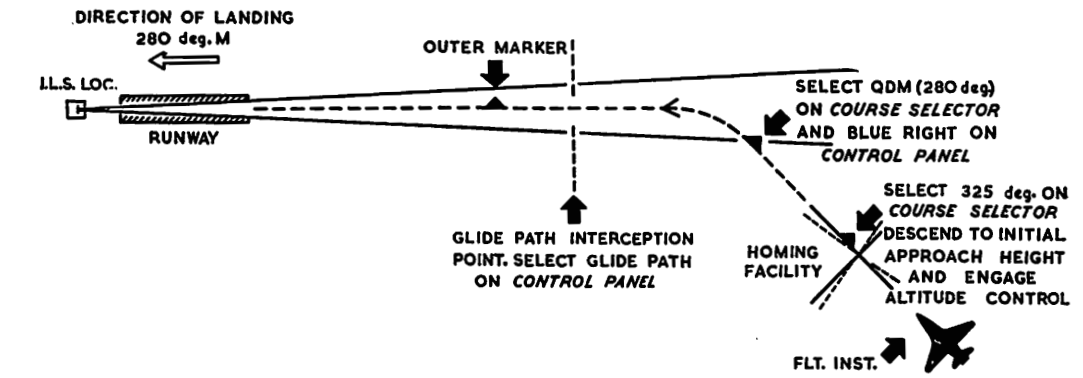
69. Select OVERSHOOT on the main selector switch and manœuvre the aircraft to maintain the indicator cross bars at zero. The pre-set climbing attitude and the heading shown on the course selector will then be maintained. At a safe height turn the main selector switch to FLT. INST., select the desired climbing angle on the pitch control knob and the required heading on the course selector.

70. The following limits should be applied during an approach as a safety measure to decide whether the aircraft is in the correct attitude for landing or if the overshoot procedure should be carried out.

71. At the middle marker, check on the I.L.S. meter that the glide slope needle is just below "on beam" and almost full scale "fly down", indicating that the aircraft is above the beam. Also check that the localizer needle is within plus or minus one dot of "on course".



OUTBOUND PROCEDURE



INBOUND PROCEDURE

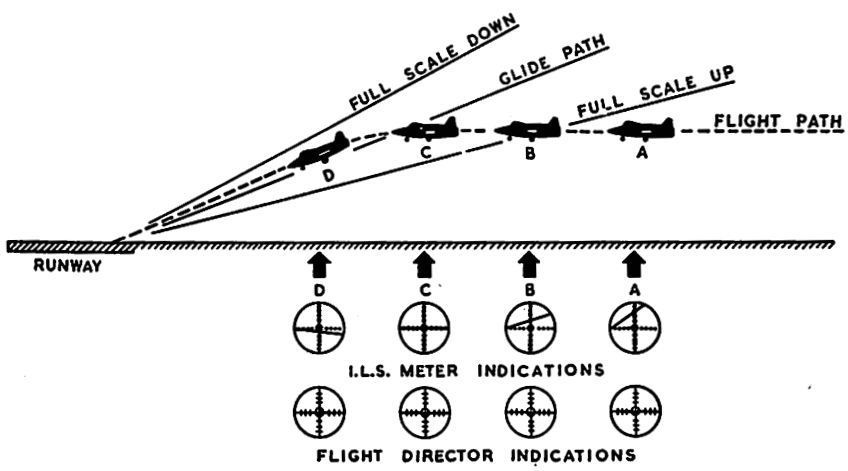


Fig. 8. I.L.S. Procedure Using the Zero Reader Flight Director.